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WORKSHOP SEMINAR ON COAGULATION AND FLOCCULATION (2nd)

Clarkson College of Technology
Potsdam, New York

21 July 1967

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REPORT

GRANT NO: WP 01131-01 ESEA (1)

TITLE: SECOND WORKSHOP SEMINAR ON COAGULATION AND FLOCCULATION

INSTITUTION: CLARKSON COLLEGE OF TECHNOLOGY
POTSDAM, N. Y. 13676

PREPARED BY

Egon Matijević

EGON MATIJEVIĆ
PROFESSOR OF CHEMISTRY

DATE: JULY 21, 1967

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DATE AND LOCATION: The Workshop Seminar on Coagulation and Flocculation was held on June 12 and 13, 1967 at Clarkson Hall, Clarkson College of Technology, Potsdam, New York.

PERSONNEL: The Workshop was organized by Egon Matijevic, Professor of Chemistry at Clarkson College.

SPONSORSHIP: The Workshop Seminar was jointly sponsored by the Federal Water Pollution Control Administration and the Institute of Colloid and Surface Science at Clarkson College. The banquet was subsidized by Amicon Corporation, Cambridge, Massachusetts.

PURPOSE: The purpose of the workshop seminar was to bring together specialists from several disciplines who are active in the study of various aspects of coagulation and flocculation phenomena. It was also the intention of the organizer to offer a common platform for discussion to researchers from the academic institutions, government laboratories, and industry.

PARTICIPANTS: The list of participants is given in Appendix A. In addition to people listed, a number of faculty members and graduate students of Clarkson College attended the sessions and participated in discussions. Eighteen universities, 12 individual research laboratories, and 5 Federal agencies were represented. Among the visitors from abroad were four from England, three from Canada, and one each from the Netherlands, Israel and Yugoslavia. Many participants had their major interest in problems of water chemistry and water pollution. The others had general interest in problems of coagulation and flocculation. Most of the participants have published papers on these problems, many of them rather extensively. Almost all who attended the seminar have been actively engaged in research on various aspects of coagulation and flocculation phenomena.

SESSIONS: In the opinion of the organizer, the major fault of most meetings is that speakers take up too much time and little or no time is left for discussion. In order to avoid this undesirable situation, there were no formal lectures scheduled at the Workshop Seminar. Four half-day sessions were chaired by four different chairmen who were asked to introduce the topic in a 20-30 minute presentation. All chairmen rigorously adhered to this schedule. The rest of the time was devoted to discussion. All participants indi-

cated on their registration sheets the topics they intended to discuss and these sheets were duplicated and distributed to all chairmen. Thus, a part of the discussion could be programmed ahead of the meeting. Each discussion contribution was limited to 5-10 minutes in order to allow maximum participation. However, each speaker could repeatedly take part in the discussion if he had several contributions to make.

This procedure resulted in a very animated discussion which did not subside during the entire conference. Also, it is difficult to think of any participant who did not take part in the work of the seminar.

The sessions were organized as follows:

Monday, June 12, morning session:

9:00-9:10 Opening of the seminar by H. L. Shulman, Executive Vice-President of Clarkson College, and

Dr. S. Brunauer, Director of the Institute of Colloid and Surface Science

9:10-11:45 First session: "Experimental Techniques and Turbidity Standards". Chairman, Dr. J. P. Kratohvil, (Clarkson College)

2:00-5:30 Second session: "Coagulation and Flocculation: Physical Aspects". Chairman, Dr. J. Th. G. Overbeek (University of Utrecht)

Tuesday morning:

9:00-12:00 Third session: "Coagulation and Flocculation: Chemical Aspects". Chairman, Dr. E. Matijevic (Clarkson College)

Tuesday afternoon:

2:00-5:15 Fourth session: "Mutual Coagulation; Coagulation and Flotation". Chairman, Dr. D. W. Fuerstenau (University of California)

5:15-5:25 Summary and Conclusions, Dr. J. J. Morgan (California Institute of Technology)

Each chairman conducted the discussion slightly differently but in each case full use of the time was made. Not to interrupt the discussion or waste time, coffee was served in the lecture room while the meeting was in progress.

The interest in the program can best be judged by the fact that at the end of the two rather strenuous days, the participation was as active as at the beginning of the seminar.

HONORARY DEGREES: In recognition of the importance of the workshop seminar with regard to the basic scientific problems discussed and specifically to the problem of water pollution, the Board of Trustees and the Faculty of Clarkson College decided to award two honorary degrees on that occasion.

The recipients were:

Dr. J. Th. G. Overbeek, Professor at the University of Utrecht, one of the world's leading authorities on problems of colloid stability, and

Dr. L. H. Farinholt, Vice-President of the Alfred P. Sloan Foundation

LOCAL ARRANGEMENTS: All participants stayed in motels. Sufficient number of rooms were reserved to insure accomodation for everybody.

In order to give ample opportunity for getting acquainted and for private discussion, the following arrangements were made:

Sunday, June 11, 7-11 P.M. Open House at E. Matijević's home which was attended by most participants.

Monday and Tuesday, June 12 and 13, 12:30-2:00 P.M., Lunch in a private dining room at the "Town House" restaurant.

Tuesday, June 12, 7-10 P.M. Banquet at the Schine Inn, Massena, New York. All participants were guests at the dinner, compliments of the Amicon Corporation, Cambridge, Massachusetts.

President of Clarkson College, Dr. J. W. Graham, Jr. greeted the group and Dr. L. H. Farinholt gave a lecture on "Science, Society and the Foundations".

SUMMARY OF THE DISCUSSIONS: Dr. J. J. Morgan summarized the

discussions and his text is reproduced here in its entirety.

"We have heard some 30 people make considerably more than that many individual presentations in the past two days. I suspect that we are all quite exhausted, and that to say very much more at this point would be a great mistake. There is no doubt that we have all, in different ways, profited greatly from our experience here at Clarkson. No summary can hope to do justice to all of the facts, ideas and viewpoints expressed in our four very lively sessions. Therefore, I will not bother you with a long list of what I have heard. Rather, I will take a minute or two to express a point of view of my own, and then I will simply mention a few of the points which seem worth emphasizing before we close the workshop.

I think it is clear that we must be aware of the technological context to which colloid and surface chemical principles are to be applied. For example, in water technology, do we seek to form aggregates of size 1/2 Å, 1 Å, 5 Å, or several hundred microns? Do we wish to sediment, float, filter, or disperse the particle systems which we start with? Are we concerned with the removal of soluble contaminants, by means of such principles as adsorption, precipitation, or foam separation? It has been properly emphasized several times during our discussions that it is more important to see the contexts of present-day and possible future applications of colloid science to water and wastewater treatment technology. For example, we have dwelt upon the "sweep zone" and the "stoichiometric zone" in water treatment for coagulative processing of waters. These are not contradictory notions, but result from the fact that there are different practically-dictated situations in which water coagulation processes are to be carried on. It has been suggested, too, that color removal, as distinct from the removal of clay particles or metal oxide particles, may be in fact chemical precipitation, not coagulation or aggregation at all. The point may be controversial, but it does make a difference, and it is important that we recognize when we are talking about the kind of process and when we are talking about another. (I forego, here, the temptation to enter upon a discussion of the meaning of the words which we sometimes use. We are clearly not all agreed upon such matters but we do not seem as excited about it as was once the case. The participants in this workshop have demonstrated their recognition of differences in the chemical specificity associated with aggregation phenomena of various kinds. That, I think, is far more important than arguing about terminology.)

What is the point then? I think it is that we should not confound the many different technological objectives in water or wastewater treatment, any more than we would try to approach

pigment design, oil recovery, or mineral precessing, in just one way. We must be at pains to try to identify the nature of the impurities and the levels of contaminant removal to be attained; then we must attempt to understand the physical and chemical (and sometimes biological) factors whth can be exploited to achieve specified objectives.

It is at this point, where we have identified the practical context, the process objectives and the characteristics of the system, that we can profitably concern ourselves with what research can tell us about the processes we should be exploiting and in what way they should be carried on. As appears to have been implicitly recognized throughout our discussions, the research problems are of two kinds. The first is to understand particle stability factors; the second to understand molecular, ionic, and particle transport forces. These two subjects, plus one other, an underlying one, have really occupied most of our attention at this workshop seminar. The "other" subject, of course, is the experimental or practical measurement of the properties of dispersed systems.

What have been some of the main points in the discussions of the past two days? The following are among the important ones, it would seem:

1. The recognition that scattering measurements at one angle may not be enough to describe changes in particle size distributions and that there are serious limitations in the use of light scattering for particle-size characterization even when Mie theory applies.

2. The suggestion of the great potential of small-angle scattering measurements in characterizing particle size and particle concentration relationships.

3. The present need for the standardization of particles for measurement of turbidities and the need for the standardization of instruments (receptor angle, path, etc.) for this same purpose.

4. The demonstrated utility of electronic particle size analyzers for the study of aggregation and break-up phenomena when the particle size exceeds about 0.6 μ and when the solution conditions (electrolytes) are appropriately chosen.

5. The importance of kinetic studies of ions, polymers, and colloid particles. We do not know enough about rates of change within the double layer, about rates of polymer or metal-ion hydrolysis product adsorption, and about rates of particle collisions relative to

these other rate processes.

6. The significance of specific chemical interactions between solution species and surfaces in governing the stability of dispersed systems. The factors which affect the adsorption or bonding of polymers, complexes, metal ions, etc. to particle surfaces are far from fully understood.

7. The need for knowledge of the geometric properties of particles in evaluating stability properties of dispersions.

8. The possible existence of attractive electrical forces between particles of like surface charge, but having different surface potential values, bringing about "mutual coagulation" between similarly charged particles.

I am sure that it is obvious to all those who have been participating for these two days that this is not a comprehensive summary. It is merely a brief attempt, at this late hour, to remind ourselves of some of the important points in our discussions.

In closing, I think that we all agree that this has been a most stimulating and profitable gathering. I know, too, that you join me in expressing our appreciation to Clarkson College for having us and in expressing our particular thanks to Egon Matijevic for his leadership in organizing and hosting this workshop seminar."

Appendix A

List of Participants

"Workshop Seminar on Coagulation and Flocculation"

Institute of Colloid and Surface Science

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